

# Increasing knowledge of the entomological fauna of the United Arab Emirates and the role of private collections

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## Abstract

Conservation of larger terrestrial organisms is easier in comparison with arthropods because those groups are more visible, are generally better known and their requirements more likely to have been described and documented. Arthropods are often very small, e.g. the average size of a beetle is 4 mm, and this means that much arthropod biodiversity has thus far not been described. Many arthropod species are of ecological importance and may be regarded as keystone species in their environment without which ecosystems would collapse. This has widely been recognized and much research is under way. Nowadays there is an urgency for arthropod biodiversity research because habitats are either being degraded, fragmented or destroyed before a baseline of the arthropod fauna has been recorded and their ecological roles have been understood. Private collections have a role in recording baseline data and may be able to provide important information in identifying indicator species, particularly where land use has changed since the date of collection. Using data from the joint Al Ain and Abu Dhabi Emirates Natural History Group private collection, this paper will illustrate how data collected over more than 20 years can assist with arthropod biodiversity research and conservation.

## Keywords

Private collections, biodiversity conservation, UAE insect fauna, Mydidae, Stratiomyidae, Buprestidae, Cicindelidae, Mantispidae, Odontomyia, Julodis candida, Pseudocastalia arabica, Atractocerus, Callytr monalisa, Mantispa nana.



## Introduction

For many developed countries worldwide a baseline of insect biodiversity has been established, and studies on insects are largely concentrated on biological and ecological aspects. However, in many countries, developed and developing, insects remain under-recorded. Without adequate knowledge of insect biodiversity, conservation strategies cannot be formulated, nor is it possible to establish a species list of notable insects, be it because they are vulnerable, threatened or endangered, or because they are keystone species. The UAE is currently undergoing development with loss, fragmentation and degradation of habitats (Gardner and Howarth 2009). This development is occurring before a baseline of insect biodiversity has been adequately recorded.

Although some collecting had occurred in the 1940's and 1950's, material from these early collecting trips were described much later (e.g. Popov 1980). Recording of insects only began in earnest in the 1980's mainly as the result of the enthusiastic activities of amateur expatriate residents (Howarth and Gillett 2008). In those early days, some individuals collected specimens, and curated specimens were collated by the newly founded Abu Dhabi chapter of the Emirates Natural History Group (ENHG). Expatriate life is transient and the individuals left the UAE and for many years, the insects collected by them remained hidden amongst other stored material until in 2005 the collection was re-discovered. At this point the Al Ain chapter of the ENHG inherited the specimens which now form part of the Joint Al Ain and Abu Dhabi Emirates Natural History Group (JAAENHG) Insect Collection.

That private entomological collections offer a significant and valuable resource not just for biodiversity research, but also can act as a baseline from which conservation endeavours can be advanced, may not always be immediately obvious. Nevertheless, by careful perusal of such collections, one can often reveal a wealth of observations and data that perhaps simply does not exist elsewhere within the formal body of knowledge built upon academic experience and scientific experiment. This can in fact be illustrated in a number of different ways, but an excellent example is to be found concerning the biodiversity within the UAE of a group of insects that are rather aptly named jewel beetles (Buprestidae).

In desert environments such as those that make up most of the national territory of the UAE, beetles or Coleoptera make up one of the major groups of animals. However, despite there being more than 150 currently recognised families of beetles (Lawrence and Newton 1995), only a few such families are extensively represented in such arid habitats. These include for the UAE, members of some of the largest beetle families such as the darkling beetles (Tenebrionidae), scarabs (Scarabaeidae), ground beetles (Carabidae), weevils (Curculionidae) and the jewel beetles (Buprestidae).

This last family as its name implies, contains many species that are brilliantly and metallically coloured and because they are also diurnal and associated with plants and often with flowers, these beetles rarely go unnoticed either by the specialized biologist or by amateur naturalists. For these reasons, one would expect that the buprestid fauna of the UAE would be relatively well known and amply recorded. Certainly lists of the known species in the UAE have been published (Gillett and Gillett 2005, Howarth



and Gillett 2008) and the more recent one includes some 19 species as shown in Table 1. It is, therefore, not only interesting, but surprising also that the authors during 2008 were able to add three more species to this list not from their own field studies, but from examination of material that had been collected by amateur enthusiasts and, at least initially, housed in private collections. It is even more incredible that the three species in question are not small inconspicuous jewel beetles, but rather are large species that would be difficult to miss if encountered in nature. The three beetles are very distinct from each other and are also unlikely to be confused with any buprestid species already known for the UAE. Each in fact belongs to a different subfamily of the Buprestidae. The three species are discussed and the circumstances that brought their presence in the UAE fauna to light are described below.

## Results and discussion

### *Julodis candida* Holyński, 1996 (Subfamily: Julodinae)

The genus *Julodis* is well known and contains two groups of large generally brightly coloured beetles that are distributed respectively in sub-Saharan Africa and in the

**Table 1.** Previously recorded species of jewel beetles (Coleoptera: Buprestidae) in the United Arab Emirates (modified from Howarth and Gillett, 2008).

Subfamily	Species
Julodinae	<i>Julodis caillaudi</i> (Latreille)
	<i>Julodis euphratica</i> Castenau & Gory
	<i>Julodis fimbriata</i> Klug
Polycestinae	<i>Ptychomus arabica</i> Gory
	<i>Acmaeoderella squamosa</i> (Théry)
	<i>Acmaeodera flavipennis</i> (Klug)
	<i>Acmaeodera guichardi</i> Levey & Volkovitsh
	<i>Acmaeodera omanensis</i> Volkovitsh
	<i>Acmaeodera pantherina</i> Bilý
	<i>Xantheremia philistina</i> (Marseul)
Chrysochroinae	<i>Steraspis arabica</i> Waterhouse
	<i>Sphenoptera arabica</i> Castenau
	<i>Psiloptera arabica</i> Gahan
	<i>Psiloptera argentata</i> (Mannerheim)
	<i>Psiloptera mimosae</i> (Klug)
	<i>Psiloptera</i> cf. <i>catenulate</i> (Klug)
Buprestinae	<i>Anthaxia abdita</i> Bilý
	<i>Anthaxia</i> sp.
	<i>Chrysobothris parvumpunctata</i> Obenberger

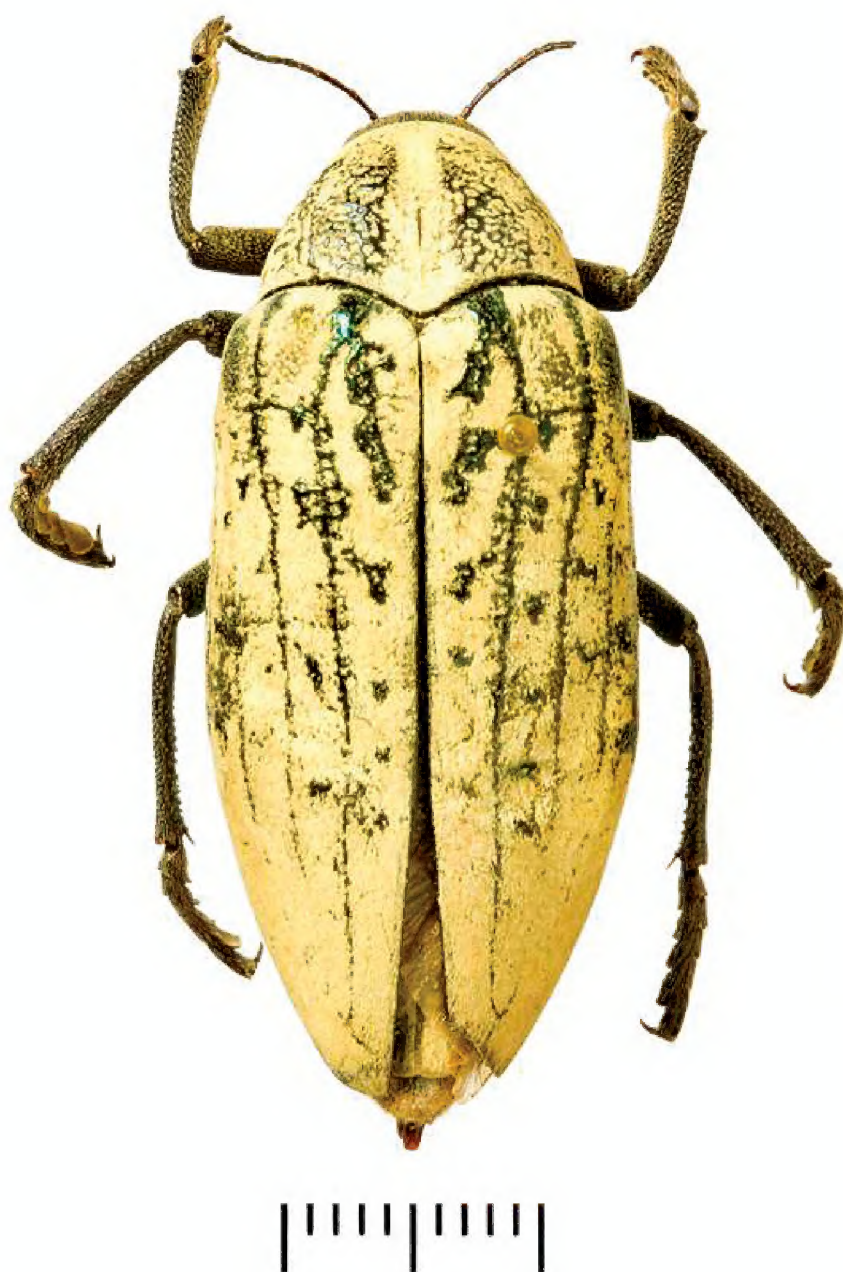


Palearctic region, including the Mediterranean Basin and eastwards into the Middle East, Arabia and Central Asia. Several species are known from Arabia including *J. euphratica*, *J. caillaudi* and *J. fimbriata* that are found in the UAE (Table 1). The species *J. candida* was described in 1996 by Holyński from a specimen previously determined as *J. caillaudi* by the buprestid specialist S. Bilý (1985) and deposited in his collection (Svatopluk Bilý, Prague, Czech Republic). This specimen, the holotype, had been collected by D. A. Pitcher in the Ain Dar area of the Eastern Province of Saudi Arabia in 1975. Two paratypes were also mentioned in the description, including another specimen collected by Pitcher in Jebel Kenzan, Saudi Arabia in 1974 and an old specimen from 1936, labelled Arabia, Shibwa (both in the Roman B. Holyński Collection, Milanówek, Poland). Until recently, these were believed to be the only specimens known, but it is quite possible that a further seven specimens also collected by Pitcher and identified as *J. caillaudi* by Bilý reside in the Manchester Museum (MM), UK (Bilý 1985). However, in 2008, during a visit to the Natural History Museum (NHM), one of the authors (MG) found two further specimens whilst examining beetle specimens in the acquisitions part of the collection. They were found in a drawer that contained UAE material from the Ian Hamer collection. Hamer was a member of the ENHG who resided in Abu Dhabi in the 1980's and who collected principally Hymenoptera, but also other insects throughout the UAE. Amongst the donated material were a number of specimens of *Julodis* that were recognizable as *J. euphratica*, but there were also two specimens that were clearly very different.

Thinking that these might represent the species *J. speculifer* (Castelnau) (a possible new UAE record), digital images were sent to Maurizio Gigli in Rome for confirmation. He was very kindly able to determine that the photographs of both specimens depicted *J. candida*. One of these specimens is shown in Fig.1. It is clearly in very good condition and like the holotype in the original description, it shows the dense creamy white pulverulence that seems to characterize this species. Based on this identification, MG was able to recall having seen two further specimens, albeit rather damaged ones, in the collection of the Environment Agency - Abu Dhabi and this was confirmed in the same year following a personal revisit to the collection.

The original UAE specimens of *J. candida* were collected in 1982 and 1984 not by Hamer himself, but by J. N. B. (Bish) Brown, the almost legendary father figure of UAE natural history. The captures were made in the Sweihan area of the eastern region of Abu Dhabi Emirate. From Hamer's private collection, these specimens found their way to the NHM a few years previously. Their subsequent discovery clearly shows the value of such collections, in this case not just by providing a new country record, in this case for the UAE, but also by providing additional new information on a very poorly known, indeed rare Arabian insect. Nevertheless, there is still much to learn about this species, including details about its host plants, seasonality and exact distributional range within the UAE. A concentrated effort by MG and Brien Holmes to find this species in the Sweihan - Al Ain area in the Eastern Region of Abu Dhabi emirate during October 2008 failed to find it.





**Figure 1.** The jewel beetle *Julodis candida*. A specimen originally collected by J. N. B. Brown in the Sweihan area, UAE, and acquired by the NHM, London as part of the Ian Hamer Collection (photograph Harry Taylor (NHM Photographic Unit)).

***Pseudocastalia arabica* (Gestro, 1877)** (Subfamily: Polycestinae)

Bilý published a series of five papers describing the Saudi Arabian buprestid fauna (Bilý 1978, 1980, 1982, 1985, 1990). In all, some 31 species of this family were listed and discussed, but one species despite its name was absent from the lists: *Pseudocastalia arabica*. This is a poorly known jewel beetle from a genus that contains about seven species of wood-boring beetles from Africa and Asia. In 2008, whilst examining beetles originally from the Abu Dhabi ENHG Collection, the authors were surprised to find a total of 16 examples of this very dark sub-metallic green beetle (Fig. 2). Even more surprising was the observation that all specimens had been correctly determined and labeled, something that was usually lacking even for common species in this collection. All had been collected in Abu Dhabi during 1988 to 1990 by Bish Brown.





**Figure 2.** The jewel beetle *Pseudocastalia arabica*. A jewel beetle from the JAAENHG Insect Collection; this specimen was originally collected by J. N. B. Brown in Abu Dhabi and kept in the ENHG Collection there (photograph by B. Howarth).

Along with the Abu Dhabi insect collection, the Al Ain ENHG had taken charge of some miscellaneous papers and letters that dealt with the collection itself. Amongst these was found a letter on NHM headed paper dated 28<sup>th</sup> September 1988 and addressed to Bish Brown. It gave the identity of a specimen of *Pseudocastalia arabica* that Brown had sent to the museum, thanked him for the specimen and reminded him that a cash remittance was required to pay for the identification! Whether it was the expense of this exercise or because the collection did not contain any other species quite as obscure as *P. arabica*, is unknown, but no other such letters have been found.

Since MG's son, Conrad, was employed by the NHM as curator of Coleoptera at the time the specimens and letter were discovered, he was asked to look for Brown's specimen in the NHM Collection. It could not be found, but the NHM did have 36 specimens of this beetle, amongst them the Paralectotype from Aden. There were 18



other examples from present day Yemen, three from present day Saudi Arabia, a couple from Somalia, one from Syria, five from India and two from Korea. Five specimens were without data, but it is impossible to say if Brown's Abu Dhabi example is amongst these. However, from this set of data, it is obvious that the Abu Dhabi material plugs a gap in the Afro-tropical – Oriental distribution of this species, as well as providing the first records from eastern Arabia.

Apparently very little is known about the biology of *Pseudocastalia* species, including *P. arabica*, except that the larvae are borers of dead wood and some species are considered to be pests (Abivardi 2001; Biosecurity Australia 2002). Indeed, there is anecdotal evidence on the internet of the related species *P. aegyptica* as a pest, infesting structural timbers in a building. There is an air of mystery surrounding the Abu Dhabi specimens of *P. arabica*. Why so many specimens from the same collection locality with no others known from eastern Arabia or since 1990 in Abu Dhabi? Why was this species, but no others, sent off to the NHM for identification? Could the beetles have come from infested timbers in an Abu Dhabi building in the 1980's? We will probably never know the answers.

### ***Capnodis excisa* Ménétriés, 1848** (Subfamily Chrysochroinae)

There are about 20 species of jewel beetles in the genus *Capnodis* and these are found in the warmer parts of the Western Palaearctic region. They are handsome beetles, often coloured black and grey or white, although some metallic forms also occur. They are known as flat-headed borers and some are important pests of fruit trees. The presence in Arabia (Kuwait and eastern Saudi Arabia) of one species of this genus has been indicated by Walker and Pittaway (1987). It is *Capnodis excisa* Menetries. This species actually has two subspecies, the nominate one is widespread, being found in Turkey and Central Asia, whilst *C. excisa alferii* Thery, 1929 is known from the Middle East. It differs from ssp. *excisa* amongst other things by the more subdued white markings on its elytra. There are apparently only two published records of this species from Saudi Arabia; four specimens that were collected by Pitcher at Ain Dar and two others from near Abqaiq found by the same collector in the Eastern Province of Saudi Arabia (Bilý 1985). All of the specimens were donated by Pitcher to the Manchester Museum, along with copious other entomological specimens.

The foodplants of *C. excisa* include *Calligonum* and *Haloxylon* and MG conducted extensive searches for the beetle on these plants in the UAE during the 1990's, but without success. The beetle is present, however, in the UAE since in November 2008, a specimen (Fig. 3) was found amongst other beetles and insects in the old collection of the Abu Dhabi chapter of the ENHG, which had been transferred to Al Ain for amalgamation with the insect collection of the Al Ain chapter.

Interestingly, during the preparation of this article, further evidence for the presence of this beetle came to light during an internet search. A photograph of the beetle, correctly identified, taken near Shiba in Dubai Emirate appeared in the online edition





**Figure 3.** The flat-headed borer jewel beetle, *Capnodis excisa*. This specimen was collected by J. N. B. Brown in the Madam area, UAE; originally in the Abu Dhabi Collection, it is now housed in the JAAEN-HG Insect Collection in Al Ain (photograph by B. Howarth).

of the Abu Dhabi ENHG newsletter Focus for November 2007 (ENHG 2007). Even more interesting was the cover photograph purporting to show *Julodis euphratica*, but which actually shows a different species, which is almost certainly *J. candida*. If this is correct, then this is the only known photograph of this species and is remarkable in that it not only shows the creamy white pulverulence mentioned above, but also orange-yellow longitudinal stripes along the centre of the pronotum and along the margins of the elytra that are not obvious either in the dead insect (Fig. 1) or the original description by Holyński (1996).

Careful examination of old insect collections will continue to add new species to regional faunas and even to science along with valuable data on distribution, biology and ecology, making them resources that need to be curated to a high standard. However, in parts of the world where the entomofauna is still incom-



pletely known, it is not enough to sit back and view such collections as the only resource available for improving knowledge. Continued new collecting by amateur and professional naturalists alike is still required, perhaps as never before as human encroachment on wild habitats increases exponentially. If such collecting stops or slows down, then it may be too late when it restarts to record tomorrow, the complete biodiversity that exists today.

In the UAE, there is an ongoing privately-funded programme aimed at producing an inventory of arthropod species within the country and the first volume of new records has been published, recording over 500 new species to the UAE in just over three years of study (Van Harten 2008). It would be easy to assume that such a programme will result in the discovery and recording of every species present in the seven emirates. On the world scale, the UAE is a small country, but in terms of collecting insects, it represents a territorial immensity to be covered by a handful of personnel and a few malaise and light traps. Along with van Harten's volume, a further publication pulls together data from the literature, along with the author's records and unpublished national data that resides in the collection of the Environment Agency – Abu Dhabi (Howarth and Gillett 2008). Combined with van Harten's records, more than 2000 species of insects are currently known to occur in the UAE, and this very likely is only a fraction of what actually occurs. This effectively means that there is still a place for private collecting either by individuals or by non-government organizations in the UAE. Some recent captures of rare insects, not just beetles, but true flies and neuropterans, by BH and other members of the ENHG illustrate this point.

### ***Callytron monalisa* (Horn, 1927) (Coleoptera: Cicindelidae)**

The tiger beetle fauna of Arabia has been fairly intensively studied with separate recent coverage of Yemen (Wranik et al. 1991), Oman (Cassola and Rihane 1996) and eastern Saudi Arabia (Cassola and Schneider 1997) adding to older records from the Red Sea area of Saudi Arabia (Britton 1948). Neither has the UAE been neglected, since separate studies have dealt with its inland (Gillett 1995) and coastal cicindelid fauna (Wiesner 1993, 1996). To date, a total of just 19 species from nine different genera are known from the whole of Arabia, suggesting that because of the size and habitat diversity of the peninsula, further species might occur.

One such has recently turned up on Reem Island, right next door to the burgeoning metropolis of Abu Dhabi, on a site scheduled for massive urban development. Two examples of this very pretty diminutive tiger beetle were collected at a mercury vapour light trap by BH on the 3rd September 2007 (Fig. 4). The beetle was identified by Cassola, and a manuscript to record this species from the UAE is in preparation (Cassola et al., in press). This represents an amazing new record and range extension of a beetle only previously recorded from Iran on the other side of the Arabian Gulf. Unfortunately, it will likely very soon disappear along with its habitat.





**Figure 4.** *Callytron monalisa*. A living specimen of *Callytron monalisa*, one of two specimens collected by B. Howarth in 2007 on Reem Island, Abu Dhabi. This rare species is known only from the Iranian side of the Arabian Gulf (photograph by D. Gardner).

***Atractocerus* sp.** (Coleoptera: Lymexylidae)

Beetles belonging to the small family Lymexylidae develop in the wood of fallen or damaged trees, feeding on fungus that grows in tunnels bored by the larvae and is an unusual family to find in the UAE. A single specimen attributable to the genus *Atractocerus* was taken at a mercury vapour light trap by BH on the 19th September 2008 in the Fujairah emirate. It is a soft-bodied beetle with only rudimentary wing-cases or elytra (Fig. 5) making it hardly recognisable as a beetle. It too is a new record for the UAE.

***Mantispa nana* (Navás, 1912)** (Neuroptera: Mantispidae)

Like many desert countries, the UAE is rich in species of nocturnal insects that belong to the order of nerve-winged insects or Neuroptera. Members of various families that include green lacewings (Chrysopidae), brown lacewings (Hemerobiidae), antlions (Myrmeleontidae), ribbon wings (Nemopteridae) and owl flies (Ascalaphidae) are all common at suitable sites (Howarth and Gillett 2008) and can often be attracted in large numbers to light traps. More recently an insect belonging to a sixth family of this order, the Mantispidae or mantis flies, has been collected and identified. It is *Mantispa nana* and has been found at a number of sites, including Al Ain and Dubai and is a further new record for the UAE.





**Figure 5.** A live example of a very strange beetle belonging to the genus *Atractocerus* (Coleoptera: Lymexylidae). This insect was photographed and collected at a MVT by B. Howarth in September 2008 in the Emirate of Fujairah and represents a new species and genus record for the UAE (photograph by B. Howarth).

### *Mydidae* sp. (Diptera)

The true flies belong to one of the largest insect orders, Diptera, which is subdivided into several suborders, the most substantial of which is the Brachycera or short-horned flies. This suborder contains more than 120 separate families that exhibit a wide range of behaviour and life histories. One of the smallest and least well known of these families is the Mydidae which contains about 400 species of mydas flies, including the largest of all described Diptera, *Gauromydas heros* (Perty 1833). The other members of the family are also relatively large insects, usually over one cm in length and many are mimics of stinging Hymenoptera (Dikow 2009). Whilst these flies are cosmopolitan in their distribution, they are more frequent in arid and semi-arid terrain, but are not often collected making them rare even in large institutional collections. The family has hitherto not been recorded from the UAE, but two unidentified species were recorded by BH within the emirates of Umm al Quwain and Dubai, with a further sighting from Dubai (Howarth 2006) (Fig. 6).

### *Odontomyia* sp. (Diptera: Stratiomyidae)

Another family of flies belonging to the Brachycera are the soldier flies, Stratiomyidae, a rather diverse family, whose larvae are often aquatic. One species belonging to the genus





**Figure 6.** An unidentified fly from the family Mydidae (photographed by D. Gardner). Whilst Mydidae had been observed in neighbouring Oman, before 2006 no records were known from the UAE.

*Nemotelus* along with a species of *Odontomyia* were recorded from the Sharjah Emirate (Howarth 2006, Howarth and Gillett 2008). The latter is the most speciose and cosmopolitan genus in the family and contains well over 200 species that are often found on flowers. The larvae are aquatic and feed on algae at the margins of fresh water (Bayless 2008).

## Conclusions

Four species are presented as new records for the UAE (*Julodis candida* Holyński, 1996, *Capnodis excisa* Menetries, 1848, *Pseudocastalia arabica* (Gestro, 1877), *Mantispa nana* (Navás, 1912), along with the record of a new genus (*Atractocerus*). Other relatively new records are discussed to illustrate the value of private collections. Within any population, some individuals will have a much greater awareness and appreciation of the natural world than the majority. Some of these individuals are drawn to particular groups of organisms and in order to make better sense out of the startling biodiversity that nature displays, they may begin to obtain specimens and form a collection. Such private collections have been historically of great importance and many such collections, both great and large, have either been bequeathed to or purchased by museums. To a very large extent, what were once private collections have now become the basis for the great museum collections and are regionally, nationally and internationally important resources for research and understanding of biodiversity and for planning and executing conservation measures aimed at preserving at least part of Earth's dwindling natural habitats.

However, far from having just a historical significance, private collections and private collecting still hold an ongoing importance both in the unraveling of biodiversity



patterns and in the fight towards effective conservation of habitats and species. In this article, the authors have drawn attention to two aspects of this importance as they relate to one small Middle Eastern country that is caught up in a spiraling process of urban development and property boom. The lesson is that both material and data still housed in old private collections and ongoing private collecting will continue to provide information vital to biodiversity conservation for a long time to come.

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## **References**

- Abivardi C (2001) *Iranian Entomology Vol. 2. Applied Entomology*. Springer, New York, 445–1033 pp.
- Bayless K (2008) *Odontomyia*. Version 28 September 2008 (under construction). <http://tolweb.org/Odontomyia/108822/2008.09.28> in The Tree of Life Web Project, <http://tolweb.org/>.
- Bilý S (1978) Insects of Saudi Arabia Coleoptera: family Buprestidae. *Fauna of Saudi Arabia* 1: 215–222.
- Bilý S (1980) Insects of Saudi Arabia Coleoptera: family Buprestidae (Part 2). *Fauna of Saudi Arabia* 2: 119–121.
- Bilý S (1982) Insects of Saudi Arabia Coleoptera: family Buprestidae (Part 3). *Fauna of Saudi Arabia* 4: 111–115.
- Bilý S (1985) Coleoptera: family Buprestidae of Saudi Arabia (Part 4). *Fauna of Saudi Arabia* 7: 160–164.
- Bilý S (1990) Coleoptera: family Buprestidae of Saudi Arabia (Part 5). *Fauna of Saudi Arabia* 11: 31–35.
- Biosecurity Australia (2002) *Citrus Imports from the Arab Republic of Egypt. A review under existing import conditions for citrus from Israel*. [www.daff.gov.au/\\_data/assets/word\\_doc/0014/24701/fin\\_egyptian\\_citrus.doc](http://www.daff.gov.au/_data/assets/word_doc/0014/24701/fin_egyptian_citrus.doc).
- Britton EB (1948) Expedition to South-west Arabia, 1937–8. 10: Coleoptera: Cicindelidae and Carabidae (with Appendix by P. Basilewsky). *British Museum (Natural History)* 1: 87–131.
- Cassola F, Rihane A (1996) Notes on the tiger beetle fauna of the Sultanate of Oman (Coleoptera: Cicindelidae). *Fauna of Saudi Arabia* 15: 196–205.



- Cassola F, Schneider W (1997) Tiger beetles (Coleoptera: Cicindelidae) from the Saudi Arabian gulf coast. *Fauna of Saudi Arabia* 16: 247–253.
- Cassola F, Gardner D, Feulner GR, Howarth B. (in press) *Callytron monalisa* (W. Horn, 1927) from the Arabian peninsula (Coleoptera: Cicindelidae). *Fauna of Arabia*.
- Dikow T (2009) Mydidae & Apioceridae. <http://www.mydidae.tdvia.de/ENHG>. [accessed 15 February 2009]
- Gardner AS, Howarth B (2009) Urbanisation in the United Arab Emirates: the challenges for ecological mitigation in a rapidly developing country. *BioRisk* 3: 27–38.
- Gillett MPT (1995) An annotated and illustrated checklist of tiger beetles from the Al Ain/Buraimi region of Eastern Arabia (Coleoptera: Cicindelidae). *Tribulus* 5(2): 13–16.
- Gillett MPT, Gillett CPDT (2005) Insects & other arthropods. In: Hellyer P, Aspinall S (Eds.) *The Emirates A Natural History*. Trident, London, 168–194.
- Holyński RB (1996) Five new species of Buprestidae (Coleoptera) from Africa, Arabia and Turkey. *Annals of the Upper Silesian Museum – Entomology* 6–7: 135–144.
- Howarth B (2006) Diptera of the UAE – collated records from the literature with additions of new records, accompanied by some notes on Mydidae and Stratiomyidae new to the UAE. *Tribulus* 16(2): 24–29.
- Howarth B, Gillett MPT (2008) The terrestrial and freshwater arthropods of Adu Dhabi Emirate. In: Perry RJ (Ed) *Terrestrial Environment of Abu Dhabi Emirate*. Environment Agency – Abu Dhabi, Abu Dhabi, 378–465.
- Lawrence JF, and AF Newton, Jr. (1995) Families and subfamilies of Coleoptera (with selected genera, notes, references and data on family-group names). In: Pakaluk J, Slipinski SA (Eds) *Biology, phylogeny, and classification of Coleoptera: Papers celebrating the 80th birthday of Roy A. Crowson*. Muzeum i Instytut Zoologii PAN, Warsaw, 779–1006.
- Popov GB (1980) Acridoidea of Eastern Arabia. *Journal of Oman Studies Special Report* 2: 113–148.
- Van Harten A (Ed) (2008) *Arthropod Fauna of the UAE: Vol. 1*. Dar Al Ummah, Abu Dhabi, 754 pp.
- Walker HD, Pittaway AR (1987) *Insects of Eastern Arabia*. Macmillan, Hong Kong, 175.
- Wiesner J (1993) Über die Cicindelidae (Coleoptera) der Vereinigten Arabischen Emirate. *Entomologische Zeitschrift* 103: 249–260.
- Wiesner J (1996) Weitere Mitteilungen über die Cicindelidae (Coleoptera) der Vereinigten Arabischen Emirate. *Entomologische Zeitschrift* 106: 382–384.
- Wranik W, Materlik B, Cassola F (1991) The Cicindelidae (Coleoptera) of the Republic of Yemen. *Fauna of Saudi Arabia* 12: 266–272.

## Postscript

Since the preparation of this manuscript the Mydidae depicted in Figure 6 and written about on p. 129 has been identified by Torsten Dikow as *Eremomidas arabicus* Bequaert, 1961. Dikow is in the process of including a more detailed analysis of Mydidae in the UAE in the latest volume of the insect inventory edited by Van Harten.